

Tulsa Tornado Tribune

Where People Who Know the Weather Get Their Weather



National Weather Service Tulsa, Oklahoma

Spring 2013

Tuesday, June 18, 2013

10 Years!

That's' right...it has been ten years since we started the Tulsa Tornado Tribune! Since the spring of 2003, we have brought you coverage of deadly tornadoes, historic blizzards...and have looked back at many historical events and tried to keep you informed on what's happening here at the office.

There have been many changes in the past ten years...not only in how we issue warnings and forecasts, but hopefully in our effectiveness in doing so (not to mention my editing skills).

It has been my sincere pleasure in bringing this newsletter to you, and I look forward to continuing...and improving!

Craig Sullivan - Editor

SEVERE WEATHER 2013

An Early Start...A Furious Finish

Tornado near Sallisaw,
OK on March 30.



Photo By Wayne Johnson

While severe weather kicked early in 2013 with a rare bout of January tornadoes, the overall season was quiet, until a series of events in late May reminded us all of nature's fury.

Information is still being gathered about the May tornadoes at this time, and we will have much more in the next edition.

For more on the recent severe weather, including specifics on tornadoes, go to pages 5-7.

SEASON OF "NEAR MISSES"

A Mild Winter That Wouldn't Give Up!

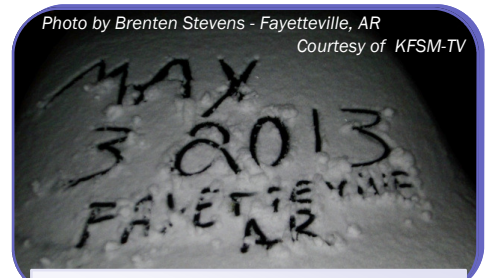
December through March were mostly characterized by what could have been.

Several systems affected the region and, while some snow and ice fell, in most cases a few degrees of cooling or 100 miles in the track could have made things a lot different.

But, this was not going to be a win-

ter that went down quietly...and snowfall history was made in the process!

Photo by Brenten Stevens - Fayetteville, AR
Courtesy of KFSM-TV



Details about the winter, and the record-breaking late snowfall are on pages 2 and 8.

ALSO IN THIS ISSUE:

Historic Late Snowfall	2
Drought Relief	3
Bronze Medal	3
Warmest Year on Record	4
Winter Twisters	5
Slow Start to Spring	6
Winter Storms	8
Fort Smith Tornado of 1898	9
40 Years Ago	11

HISTORY MADE!

New snowfall records:

Latest snow in Tulsa: May 2

Latest measurable snow in Fayetteville: May 3

Latest measurable snow in Arkansas: May 4

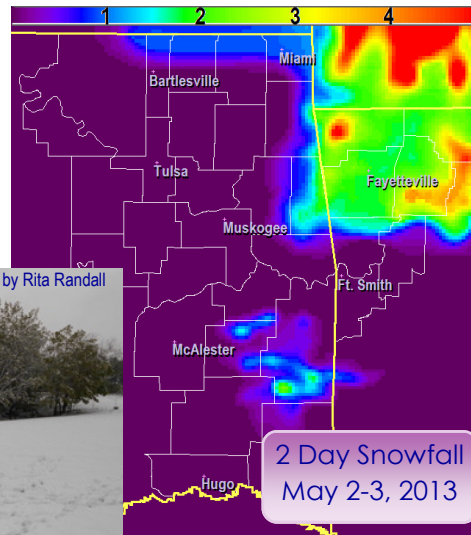
Highest 2 Day Totals

5.0	3 ESE Decatur, AR
3.5	Gravette, AR
3.0	Westville, OK
3.0	Siloam Springs, AR
3.0	Gentry, AR
2.9	7 NE Winslow, AR
2.5	Bella Vista, AR



This picture was taken about an hour after the 5" snowfall was measured by the CoCoRaHS observer near Decatur, AR.

level highs over the Pacific Northwest and the northwest Atlantic have funneled cold Canadian air southward into the plains. Arguably the strongest front of the season, at least in terms of departure from normal temperatures,



plunged south on May 2. At the same time, a slow moving "cutoff" low drifted over the area, with precipitation developing over eastern Oklahoma and northwest Arkansas along and behind the front.

Typically a May cold front equals severe weather, but this time, the

In an area known for wacky weather, it's surprising how close we often follow the astrological seasons with regards to extremes; triple-digit heat is rare before the summer solstice for example...as is snow after the beginning of spring. The fun thing about weather, of course, is the events that fall way on the far end of the spectrum of what seems possible. Such an event unfolded as the calendar recently turned to May...normally the penultimate month of severe weather season.

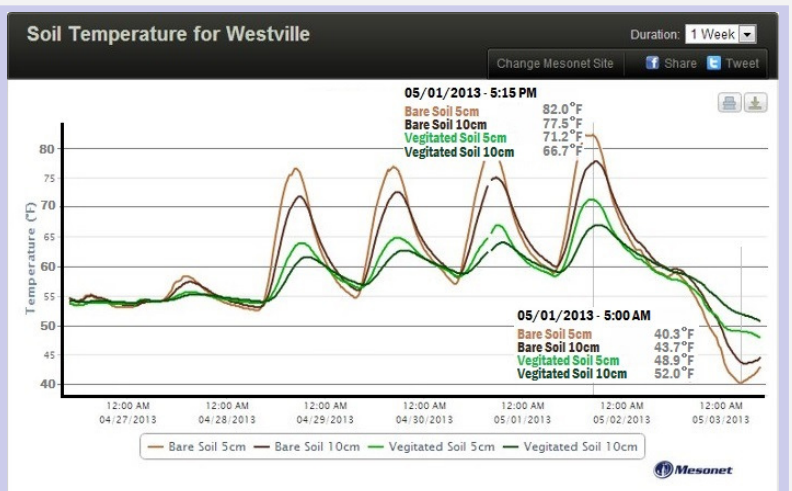
As we alluded to, winter had a difficult time letting go in 2013. Through a good portion of spring, strong upper-

unusually cold air actually allowed for sleet and snow to mix in with the rain across northeast Oklahoma during the afternoon and evening of May 2. Snowflakes were first observed at the NWS Tulsa office at 1:40pm CDT, making May 2, 2013 the latest observed snow in Tulsa since records began in 1900! This also marks the first time snow has fallen in Tulsa in the month of May. As the precipitation continued to spread east overnight and colder air aloft moved over the area, much of the rain changed to snow over far northeast Oklahoma, the high-

HISTORY Continues on page 4

Too Warm for Snow to Stick?

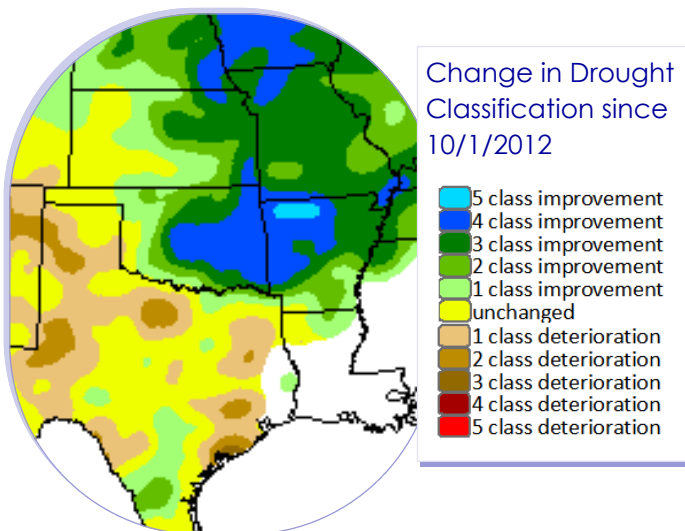
Leading up to this event, high temperatures on April 29, April 30, and May 1, 2013 were all in the 80s across eastern Oklahoma and northwest Arkansas. Likewise, 5cm soil temperatures had warmed into the 70s to low 80s across the area. The question of ground temperatures often comes up before a snowstorm in this part of the world. However, as seen on May 3, snow of sufficient intensity, especially at night, will accumulate despite ground temperatures well above freezing. With these conditions, the snow might not affect roads much, and 100% of the snow will not stick, but some will. In the below images of the Westville, OK mesonet soil temperature plots, there is the 40°F temperature drop at the 5 cm layer below bare ground. ❄️



DROUGHT RELIEF

Winter storms and spring rains have eased or even eliminated drought conditions for most of the area. But...haven't we seen this before?

At the end of fall 2012, the region was still experiencing a persistent drought, with much of the forecast area under extreme drought. November through December precipitation was below normal in most of eastern Oklahoma and northwest Arkansas...especially northeast Oklahoma where the drought category increased to D4 (exceptional) in some locations.



Above normal precipitation fell across much of eastern Oklahoma during February, helping to reduce the drought severity by one whole category in most areas. After a relapse of dry weather in March, the relief that began in February picked up some serious momentum through April, with a large section of east central Oklahoma and northwest Arkansas seeing from 150 to 200 percent of the monthly normal. The trend continued through May, with many areas receiving at least twice their normal monthly rainfall.

However, the long term rainfall deficits are still with us. For the water year to date (since October 1, 2012), a significant portion of eastern Oklahoma and western Arkansas remains at less than 75 percent of normal precipitation for the period...and with summer approaching we are not out of the woods just yet!

A JOB WELL DONE!

Tulsa NWS office receives Department of Commerce Bronze Medal for the Blizzard of 2011.



The National Weather Service in Tulsa was awarded a prestigious Bronze Medal award by the Department of Commerce during a ceremony in Washington, D.C. On May 7, 2013. The award was based on the outstanding service and selflessness of our staff during the historic blizzard of early February 2011, which broke an all-time 24 hour record snowfall in Tulsa.

Many of our staff had to sleep at the office, work double shifts, and brave awful conditions to provide the best service to the citizens of eastern Oklahoma and northwest Arkansas. And, of course, we would do it all over again in a heartbeat if we ever had to!

For the full story on the historic winter storm of February, 2011, go to:

http://www.srh.noaa.gov/tsa/?n=weather_event_2011feb1

WARMEST YEAR ON RECORD

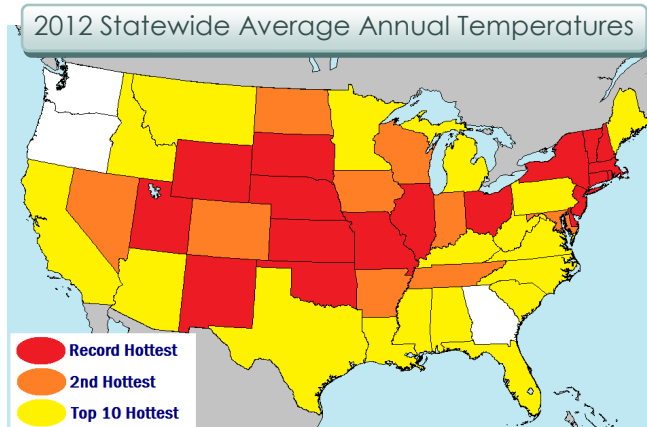
2012 breaks records for temperature locally, statewide and nationally.

Most people across eastern Oklahoma and northwest Arkansas will recall the summer of 2012 was really hot. But, did you realize that above normal temperatures occurred every month except for one in 2012? As a result, Tulsa, OK, Fort Smith, AR, and Fayetteville, AR all recorded their warmest year in 2012 for their respective periods of record. March averaged around 10°F above normal, making it the warmest on record, and several other months saw average temperatures at least 5°F above normal.

More importantly, 2012 was defined by the Severe to Exceptional Drought that affected the region for much of the year. The 2012 Drought was actually an extension of drought conditions that began in October 2010. Rainfall totals for 2012 ranged from roughly 50% to 90% of the normal annual rainfall across eastern Oklahoma and northwest Arkansas, though a few pockets of 25 to 50 percent of nor-

mal were found in Pawnee and Tulsa counties, as well as Washington County, AR. Fayetteville recorded its fourth driest year on record (1950-2012).

The state of Oklahoma also recorded its warmest year on record in 2012 with an average temperature of 63.0°F, just edging out 1954. This was also the 12th driest year on record for Oklahoma. The state of Arkansas ranked as the 2nd warmest and 10th driest year on record.



But, it didn't stop there. According to the National Climatic Data Center, in 2012, the contiguous United States average annual temperature of 55.3°F was the warmest year in the 1895-2012 period of record for the nation....and was 1.0°F warmer than the previous record warm year of 1998. In all, 19 states had their warmest year on record. All of the lower 48 states were above normal for the year, and only Washington, Oregon and Georgia failed to land in the top ten! 🌞

Cool Spring = Cool Summer?

After enduring the last few summers, this editor has officially become desperate to find any hope that the summer of 2013 will be different!

Last year we noted there was some correlation between the top warmest springs and above normal temperatures for the following summers...which held true in 2012. So, since spring 2013 was much cooler than normal (4th coldest on record at Tulsa and Fayetteville), perhaps there is a trend in the opposite direction.

Alas, there is none. Looking at the top ten coolest springs for both Tulsa and Ft. Smith, the results show about an even split of above or below normal temperatures for the following summer. 🌧️

HISTORY

(Continued from page 2)

er elevations of southeast Oklahoma, and northwest Arkansas. Snowfall totals of 1 to 2 inches were common by the morning of May 3, with amounts of 3 to 5 inches in Adair County, OK and Benton County, AR. This was the first time in recorded history snow fell in the state of Arkansas during the month of May.

This record for Arkansas was very short lived...about 24 hours to be exact...as another round of snow affected mainly northwest Arkansas the next night with precipitation wrapping around the upper-level low along the Arkansas-Missouri state line. Overall, this snowfall was much lighter than the previous night, but the higher elevations did receive near 2 inches of additional snow. The heavy wet snow accumulated on trees with leaves, an extremely rare occurrence here, and actually led to sporadic power outages. Of course, the snow melted quickly, but left residents with something to talk about for years to come! 🌨️

WINTER SEVERE STORMS

December 19

December started out very warm, with spring-like conditions leading to severe weather during the evening. A line of severe thunderstorms developed along a cold front across eastern Oklahoma, and moved toward the east, producing large hail and damaging winds across southeast Oklahoma and western Arkansas.



Double-wide mobile home destroyed northeast of Lavaca, AR by December 19, 2012 tornado.

A tornado formed out of one of these storms

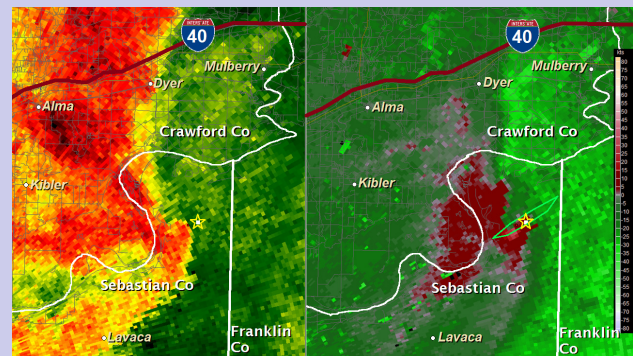
in northern Sebastian County, damaging numerous trees, along with several homes and outbuildings. Straight-line wind gusts of 63 mph were also measured at Fort Smith Airport. ⚡

Communicating Uncertainty

The December 19 severe weather mode was primarily linear, as expected. However, conditions did support a threat of brief squall-line tornadoes as strong low level wind shear was present ahead of the line of storms. This threat was highlighted by the NWS Tulsa in the late afternoon Hazardous Weather Outlook, which stated...

"STORMS WILL DEVELOP INTO ONE OR MORE LINES WHICH WILL ENHANCE THE DAMAGING WIND POTENTIAL. THE WINDS ALOFT ALSO APPEAR SUPPORTIVE OF BRIEF TORNADOES WITHIN THESE LINES OF STORMS. SHOULD THESE TORNADO SIGNATURES DEVELOP THEY WILL BE BRIEF AND LIKELY PRECEDED WITH LITTLE TO NO WARNING."

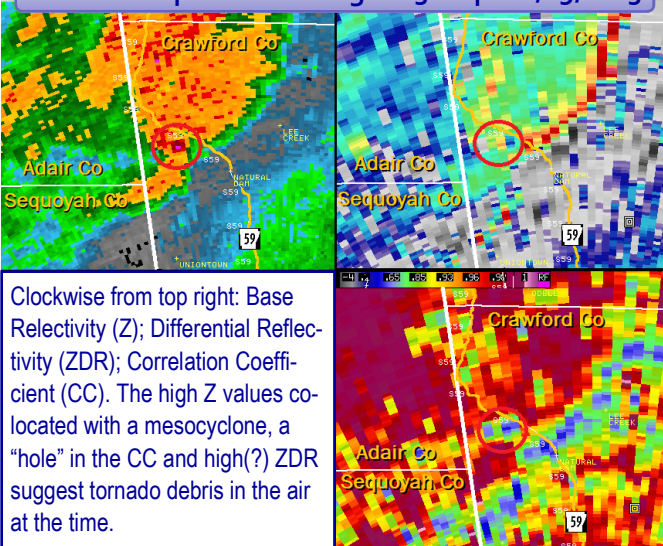
The Sebastian County tornado was a non-supercell tornado, with a radar signature that appeared quickly. But recognizing this *potential* gave forecasters the chance to communicate the possibility, and greater confidence to issue a tornado warning... albeit with little lead time!



January 29

Unusually warm and spring-like weather returned in late January. Severe storms formed in the late after-

KSRX Dual-pol Radar Images - 3:00 pm 1/29/2013



Clockwise from top right: Base Reflectivity (Z); Differential Reflectivity (ZDR); Correlation Coefficient (CC). The high Z values co-located with a mesocyclone, a "hole" in the CC and high(?) ZDR suggest tornado debris in the air at the time.

noon when a strong low pressure system and cold front pushed across the area. In addition to many damaging wind events across northwest Arkansas, a supercell ahead of the main line of storms spawned three tornadoes.

The first, and strongest, tornado developed in extreme northeastern Sequoyah County, OK a little before 3 pm, and eventually crossed the state line and tracked through part of Crawford County. The most pronounced damage occurred on Rainwater Road northwest of Uniontown, AR.

A second tornado touched down in Washington County, AR, damaging 40 to 50 homes...some had part of their roofs blown off. Another twister struck near McIlroy Wildlife Management Area, destroying several barns and damaging two homes along Highway 221. Several cows and calves were killed by debris. ⚡

SLOW START TO SPRING

March 30 Supercells

Below normal temperatures through much of March held the spring severe weather season at bay most of the month. March did go “out like a lion” however, as several discrete supercells developed in a very unstable airmass during the afternoon and evening of March 30, as a cold front pushed southeast into and through Eastern Oklahoma and Northwest Arkansas.

These thunderstorms moved east and southeast ahead of the frontal boundary. Several thunderstorms became severe, with numerous reports of hail up to golf ball size and a few up to the size of baseballs. One severe thunderstorm in particular traveled southeast through Wagner, Muskogee and Sequoyah counties in Northeast Oklahoma during the late evening hours producing two brief tornadoes; one near Fort Gibson, and the other near Sallisaw (photo on page one).



Storm Photo taken at 8:54pm CDT 3/30/13 by Von Castor (Fox23) near Muskogee ,OK

Damage with the twister near Ft. Gibson was limited to a center-pivot irrigation system, the roof of one permanent home and a handful of barns. Several large tree limbs were snapped and a couple of power poles were blown down. The Sallisaw tornado did a bit more damage, destroying several wood-framed barns and outbuildings. The tornado also severely damaged the roof and windows of a permanent home. ⚡

April 17/18 Squall Line

Photo by Russell Mills - courtesy KRMG



Double-wide mobile home lifted atop a house in Spavinaw, OK

During the evening of the April 17, 2013 and into the morning of the 18th, severe thunderstorms and flooding occurred across northeast Oklahoma and northwest Arkansas. On the morning of the 17th, a warm front surged north into Kansas and Missouri setting the stage for the severe weather and flooding later in the evening. Thunderstorms devel-

oped along the front as it moved into Central and Northeast Oklahoma as a cold front during the afternoon and evening hours of the 17th. As the front moved slowly to the east, storms moved to the northeast along the frontal boundary, leading to flooding as the storms moved repeatedly across the same area.

The main severe weather event occurred with a line of severe thunderstorms late in the evening into the early morning hours. This line of thunderstorms evolved into a bow echo and moved swiftly across northeast Oklahoma and northwest Arkansas, producing wind damage, large hail, and several tornadoes. The tornadoes were associated with brief circulations that likely evolved from the interaction of thunderstorms with the near stationary frontal boundary.

A pair of brief tornadoes touched down in Broken Arrow around midnight, the second of which severely damaged the second floor of a house. A short time later, three small twisters struck near Inola, OK, one overturning several train cars and another damaging a number of homes and outbuildings.

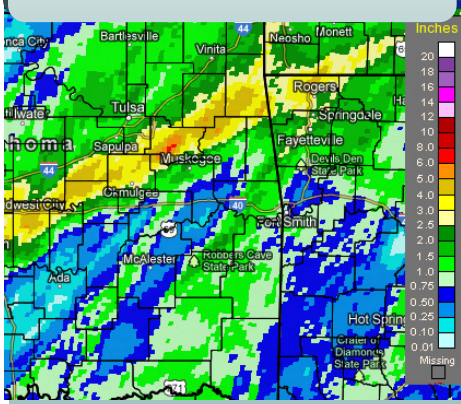
Shortly after 1 am, a tornado developed southwest of Spavinaw, OK, snapping and uprooting numerous trees as it approached the town. The twister passed through the small town, damaging numerous homes, and demolishing several mobile homes. The roof of the school was also severely damaged, as were several businesses.

SLOW START Continues on page 7

SLOW START *(Continued from page 6)*

The final confirmed tornado of the night was also the strongest, striking near the Butler community south of Grove, OK. The most intense stage of this tornado's lifecycle was early on as it produced an 800 yard wide corridor of impressive tree damage and severely damaged a permanent home. Numerous trees were snapped and uprooted, power poles were blown down, homes were damaged, and barns were destroyed as the tornado moved northeast. It dissipated about 2 miles west of the Missouri state line.

24-hr Rainfall Totals ending 2pm CDT April 18, 2013



The intense line of storms also produced very heavy rainfall. Flooding was widespread across east-central Oklahoma into far northwest Arkansas, where 24 hour storm-total rainfall amounts reached 3 to 5 inches with isolated reports of up to 7 inches. Several State Highways were impassible due to high water, as were many smaller city, town, and county roads. The heaviest rain fell over the Deep Fork River and Illinois River basins, causing flooding along Flint Creek near Kansas and the Illinois River near Watts and near Tahlequah. ⚡

Confirmed Tornadoes for 2103 - Through April 30

Time	County	Location	Length	Width	Wind	Remarks
January 29						
2:55 pm	Sequoyah/Crawford	2.6 NNW Short, OK - 3 NW Lee Creek, AR	10	700	120	EF2: 1 home destroyed
3:34 pm	Washington	3.5 WNW - 4.5 N Elkins	4.2	400	105	EF1: 50 homes damaged
3:57 pm	Madison	1.6 NW - 1.6 NNE Rockhouse	2	350	110	EF1: several outbuildings destroyed
March 30						
9:35 pm	Muskogee/Wagoner	1.8 ESE Wybark - 2.2 WNW Ft Gibson	1.1	200	85	EF0: center-pivot irrigation system damaged
11:20 pm	Sequoyah	.6 WSW - .4 SSW Sallisaw Airport	0.5	175	110	EF1: Few barns destroyed
April 17-18						
11:50 pm	Tulsa	5.5 S - 5 S Glenpool	0.5	50	70	EF0: Media observed
12:01 am	Tulsa	3 NE - 3.1 NNE Bixby	1.3	250	85	EF0: several homes damaged
12:03 am	Tulsa	2.2 NE Bixby - 3.9 SSE Broken Arrow	2.1	400	100	EF1: 1 home severely damaged
12:28 am	Rogers	4 SSW - 2.3 SSW Inola	0.9	125	75	EF0: barn severely damaged
12:29 am	Rogers	2.4 SW - 0.9 S Inola	1.8	140	110	EF1: rail cars blown over mobile home destroyed
12:33 am	Rogers	.3 SSW - 1.4 ENE Inola	1.9	180	95	EF1: metal frame building damaged
12:48 am	Mayes	5.4 NE Chouteau - 2.4 NW Salina	6.5	100	95	EF1: industrial building damaged
1:07 am	Mayes	2.1 SW - 1.4 NE Spavinaw	3.5	350	110	EF1: 2 injured; several mobile homes destroyed; school damaged
1:30 am	Delaware	4 E Zena - 7 SE Grove	8	800	125	EF2: homes severely damaged

Preliminary Information on May, 2013 Severe Storms

A hectic period of severe weather struck Oklahoma and Arkansas during late May, after a quiet start to the season. At least two dozen tornadoes have been documented in the NWS Tulsa forecast area as of June 7, and more may be added to the total.

Supercell storms near the Oklahoma City area on May 19th and again on the 20th spawned two deadly twisters...an EF-4 west of Shawnee, OK on the 19th, then the devastating EF-5 in Moore, OK on the 20th. Debris from both the Shawnee and Moore tornadoes have been found in portions of eastern Oklahoma. The storms gradually weakened as they moved into eastern Oklahoma on the 19th, but did produce two tornadoes. The next day's storms progressed farther east, producing several tornadoes in eastern Oklahoma and western Arkansas through the evening.

The volatile pattern returned to close out the month, with several bouts of severe weather from the 29th through the 31st. Several tornadoes struck eastern Oklahoma and western Arkansas on both the 30th and 31st along with very heavy rainfall in some areas. The Oklahoma City area was again hit hard on the 31st, with damaging tornadoes and devastating flooding.

These events will be covered in much more detail in a special edition of the Tulsa Tornado Tribune, which should be out in a month or so. In the meantime, details can be found on our weather events page at: <http://www.srh.noaa.gov/tsa/?n=sigwxevents>.

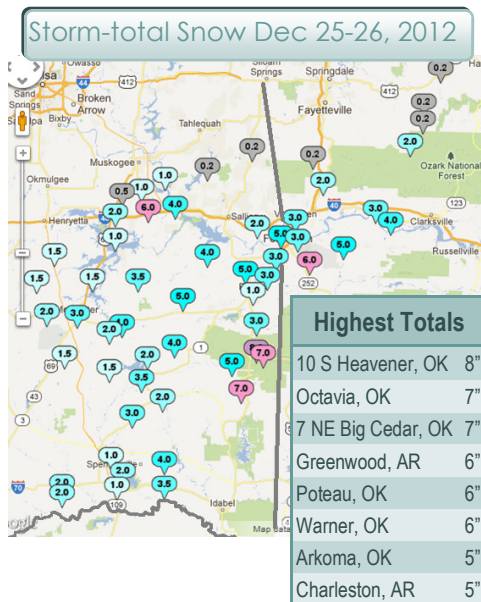


Tornado in Broken Arrow, OK on May 30. Photo by Jeff Piotrowski

WINTER STORMS 2012-13

White Christmas for Some

The first real taste of winter weather conveniently arrived just in time for Christmas, as a strong low pressure system moved over the region Christmas Day. While it was initially thought most of the snow would fall along and south of Interstate 40, the system tracked a little more south than expected, shifting the snow band across southeast Oklahoma and west central Arkansas. A band of 4 to 6 inch accumulations was observed there, with as much as 8 inches reported 10 miles south of Heavener in Le Flore County. Fort Smith officially received 4 inches, while areas as far north as Tulsa and Fayetteville only received a trace of snow, with a little very light sleet and freezing rain.



Better Late Than Never?

February proved to be a colder and wetter month with a series of storms impacting the region. One such system on the 12th brought widespread rain ahead of the approaching upper-level low. By mid-morning, temperatures had cooled enough for a change over to snow across the western portions of Osage and Pawnee Counties. As the cold core low moved into northeast Oklahoma during the evening, the transition from rain to snow continued mainly north of I-40. However, with surface temperatures remaining at or a little above freezing, precipitation changed back and forth between rain and snow, causing much of it to melt as it fell.

In general, accumulations were 0.5 to 1.5 inches, mainly near the Kansas border in northeast Oklahoma and in

the higher elevations of north-west Arkansas. Of note with this system...the 0.1 inch of snow at Tulsa is the second latest date the first measurable snow of the season has been observed.

Latest First Measurable Snow at Tulsa, OK

March 7	1931-32
February 12	2012-13
February 6	1970-71
February 5	1980-81
January 30	1964-65, 1981-82

A Little of Everything

The most significant winter event in terms of impact struck on February 20-21, bringing a mix of snow, sleet, and freezing rain to the area...and even a little hail! Precipitation began mainly as snow and sleet during the morning of the 20th north of a warm front located near the Red River. Again, temperatures were generally a few degrees either side of freezing, causing precipitation type to transition back and forth between rain, snow, and sleet throughout the day. Snow accumulated primarily on grassy surfaces and, again, much of it melted as it fell. Roads did become slick during periods of heavier snow, but conditions improved quickly as snow rates eased.

Snow accumulations were mostly from 1 to 4 inches, with highest totals near and just north of I-40. Sleet accumulations of an inch were reported in Carroll and Madison counties. By mid-evening, precipitation changed to freezing rain in some areas as warmer air aloft moved into the region. Icing conditions were worst across extreme northeast Oklahoma and northwest Arkansas, with some damage to tree limbs in Carroll and Washington Counties.

A Close Call

Another powerful low pressure system moved across north Texas on February 25th before lifting northeast over Arkansas on the 26th. This time, the "near-miss" involved geography, as much of western and northwestern Oklahoma saw from 12 to 18 inches of snow, with blizzard conditions causing zero visibilities, widespread power outages, and closed interstates.

Showers and thunderstorms initially affected eastern Oklahoma and western Arkansas during the day on the

THE FORT SMITH TORNADO OF 1898

An unusually sultry winter night 115 years ago turned tragic, as a violent tornado struck Fort Smith, Arkansas during the night of January 11, 1898. The death toll of 55 remains tied for the highest from a single tornado in the state of Arkansas.



Fort Smith High School as it appeared before and after the tornado. The building had been completed only a few months earlier.

It's hard to imagine a scenario much worse; a time of year when tornadoes don't often strike, a large, violent tornado bears down on a population center late at night. This is exactly what took place on January 11, 1898 when a spring like system spawned what was, in all likelihood, a family of tornadoes from present-day southeast Oklahoma (Indian Territory at that time) into western Arkansas. There were accounts of a funnel cloud near Hartshorne, OK in Pittsburg county an hour or so earlier, and of a tornado sighting along the Arkansas River a little west of Fort Smith.

Shortly after 11 pm, the violent twister struck the city near the National Cemetery (*Location 1 on map*) and swept its way through the heart of the town. Leaving Fort Smith, it bounded toward Van Buren and continued down the river, demolishing everything in its path. At the cemetery, a number of trees were uprooted and demolished the keeper's residence. As it continued moving east-northeast through the heart of the sleeping city, it leveled dozens of homes

The following are excerpts from the notes on this tornado made by J.J. O'Donnell, the observer at the Fort Smith Weather Bureau office on the night of January 11, 1898.

At Fort Smith, at 5:15 p.m., the cumulo-stratus clouds were moving rapidly from the south and southwest, mingling in the usual manner of such clouds...

Shortly after 6 p.m., these cumulo-stratus had changed somewhat in color, from dark gray to bluish-green, being inky black on the edges and but slightly mottled in the center. As the night approached the bluish-green became deeper...

At 8 p.m., while observing the clouds, the wind vane veered to the south with a jerk that almost wrenched it from its support, but immediately backed slowly to east and remained steady; the clouds were a sheet of unbroken stratus moving from the west, and seemingly lower than before...

At 9 p.m., when changing the thermograph sheet, the wind was still steady from the east; intense darkness prevailed in the west and north...not a trace of lightning anywhere...

At 9:35 p.m. the first lightning was observed, very low in the southwest horizon...By 10 p.m. (lightning) reached an altitude of 50°...

At 11:10 p.m. the first thunder was heard, coming from the southwest; then, at intervals of six or seven minutes, it was repeated until the tornado struck...

About 11:30 p.m. the lightning became more concentrated in the southwest, the flashes, radiating fan-shaped from a center in luminous beams, reaching to the zenith...frequent sheet lightning illuminated the whole southern and western sky, exhibiting dense masses of broken cumulo-stratus clouds, meeting and uniting as they passed rapidly eastward...

As the clock was striking midnight and the office was about to be locked up, the barometer reading 28.846, actual, the wind south, not a drop of rain having fallen, the air feeling sultry and very damp, and while the book of mean pressures was being examined for comparative barometer readings, a gurgling noise was heard, like water rushing out of a bottle, followed immediately by a rumbling, such as that made by a number of heavy carriages rolling rapidly over a cobblestone pavement, and finally like a railroad train. These three noises appeared in this order of succession; each was distinctly different and clearly distinguishable from the other. This noise or roar is entirely peculiar to itself, though resembling those just mentioned, and is always recognizable as the "tornado roar." About two seconds elapsed between the first roar and the rattling and quivering of the office window by the wind and the terrific driving rain which at once forced itself in between the frame and the sash, at the top, the bottom, and the sides, and flooded the office. The book of means was laid aside and the observer went to the landing in the large skylight on the roof of the observatory, whence he saw the tornado cloud 450 feet distant to the southward, a twisted black mass of two clouds, accompanied by lightning from the upper parts of the clouds. The lightning was a continuous series of flashes of a pale yellow color; the noise of the thunder sounded like the muffled beating of a number of drums within the cloud. The clouds appeared like inverted siphons, each curved over downward from the right or left hand side of the cloud, respectively, to the center, where they came in contact with each other and twisted about one another downward to the ground, being narrowest about 40 feet from the ground and, probably, about 100 feet high.

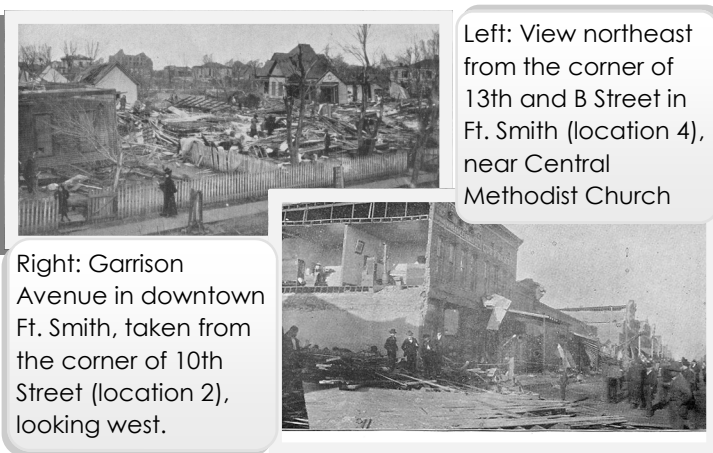
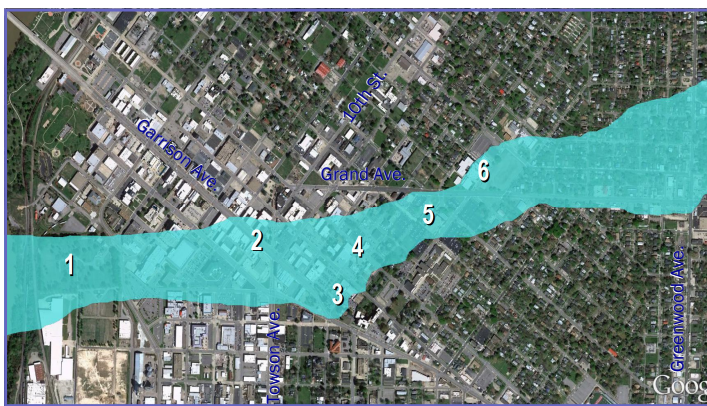
FORT SMITH (Continued from page 9)

and businesses, and tore off the upper stories of large brick buildings. A number of the damaged structures also caught fire.

At the time, Federal court was in session, and that brought a great many farmers into town, who crowded the boarding houses and wagon yards. There were 33 people killed outright and at least 19 more died from injuries. Sixteen people died in a single residential block. The number of serious injuries topped 100. The tornado continued to the east-northeast, crossing the Arkansas River south of Van Buren, where three more people were killed as farms were destroyed. A Fort Smith street sign from the corner of 13th and Garrison (*location 3*) was found 22 miles away. Roofing shingles were carried for 35 miles.

The tornado devastated the city's main business district, destroying a number of grocery, dry goods and feed stores vital to the area's residents. Burgess's Hotel, a three-story brick building on Towson Avenue, was demolished, with several of the fatalities occurring there. The National House, a two-story building, was also demolished, but all inside somehow escaped without serious injury. Fort Smith's new high school building (*location 6*) was badly wrecked, but was one of the few buildings insured for losses. That building was located where Darby Junior High School now stands. The First Baptist Church (*location 5*) and the Central Methodist Church were reduced to rubble. The Church of the Immaculate Conception and Brownscomb Memorial Church lost their spires and sustained other damage.

Approximate swath of damage in Ft. Smith from the 1898 tornado. The damage path was re-created from a real estate map of early Ft. Smith (courtesy of the Fort Smith Historical Society) and overlaid on Google Earth imagery from March, 2012.



Adjusted for inflation, the 1898 Fort Smith tornado ranks 21st on the list of most damaging storms in United States history from 1890 to present. 🌩️

WINTER

(Continued from page 8)

25th, but by late afternoon, rain changed to snow across north central Oklahoma, with some sleet in northeast Oklahoma. Precipitation finally changed to snow across all of northeast Oklahoma and northwest Arkansas overnight. Snowfall totals ranged from 1 to 3 inches along the I-44 corridor, with up to 5 inches in parts of Osage and Washington Counties. The snow mainly accumulated on grassy surfaces and melted on roadways...again... limiting the overall impact.

Whither Spring?

Finally, as the calendar turned to spring, it was becoming clear that this winter was not going down without a fight. A very strong cold front moved through on April 10th, with sharply falling temperatures and a cold rain continuing behind the front. The air temperature reached freezing while it was still raining along the Kay-Osage County line, with reports of tiny icicles on tree branches on Kaw Lake. However, the higher ice accumulations and related power outages remained west of the forecast area...another "near miss". ❄️

Two days after an historic breakthrough in tornado re-search (story on page 12), a dozen tornadoes descended on eastern Oklahoma and northwest Arkansas, killing 5 and injuring dozens more.

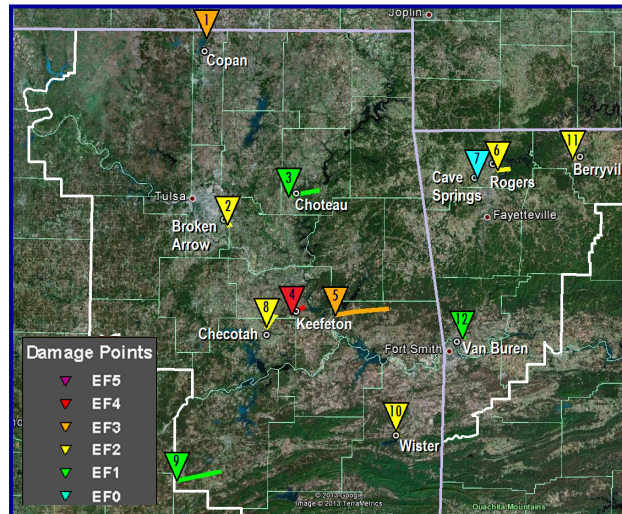


Service station destroyed by the May 26, 1973 tornado at Keefeton, OK. The owner was one of five people killed in the storm.

Severe weather came in two rounds; the first developing in the afternoon, with a second round of storms late in the evening. The first reported tornado of the day touched down on U.S. Highway 75 near Copan, OK (Washington Co.) around 4 pm, striking two cars on the highway and injuring 3 people. At about the same time, a tornado touched down east of Broken Arrow, OK (Tulsa Co.) and damaged several structures. Thirty minutes later, a twister damaged several small structures along a 4 mile path between Choteau and Locust Grove in Mayes County, OK.

The afternoon turned deadly a short time later. A violent tornado formed at about 5:00 pm about 1/4 mile

Forty Years Ago - May 26, 1973 Tornadoes



May 26, 1973 Tornadoes

	Time (CDT)	County	Killed	Injured	Width	Length
1	4:00 pm	Washington	0	3	100 yd	500 yd
2	4:00 pm	Tulsa	0	0	33 yd	2 mi
3	4:30 pm	Mayes	0	0	60 yd	10 mi
4	5:00 pm	Muskogee	5	25	500 yd	3 mi
5	5:40 pm	Sequoyah	0	6	250 yd	18 mi
6	6:00 pm	Benton	0	0	100 yd	5 mi
7	6:55 pm	Benton	0	0	100 yd	0.5 mi
8	9:00 pm	McIntosh	0	0	200 yd	5 mi
9	9:10 pm	Pittsburg	0	0	80 yd	15 mi
10	10:00 pm	Le Flore	0	0	33 yd	1 mi
11	10:25 pm	Carroll	0	2	200 yd	2 mi
12	10:30 pm	Crawford	0	23	100 yd	1 mi

southwest of Keefeton, OK in Muskogee County and moved to the east-northeast right through the heart of the small community, damaging or destroying nearly three-fourths of the structures in town. A family of five was caught in their pickup truck as they tried to reach the schoolhouse cellar about a mile from their house. The truck was carried or rolled for a half-mile, killing four of them...the other was critically injured. Another person died from injuries received

when his house and service station was destroyed. Another 19 people were injured seriously.

In all, eight homes, five businesses and a church were destroyed. The twister left only two commercial buildings standing - a cafe at the northwest edge of town and a slaughterhouse at the southeast edge. The community never fully recovered from the disaster. There were three neighborhood stores before the tornado...two were destroyed by the storm and never rebuilt. Today, the slaughterhouse is still there, and, among a few overgrown foundations that tell of the tornado, there are also a combi-

nation store and service station, a barbecue eatery, two churches and a scattering of homes. The community no longer has a post office. At the time of the tornado, the former Keefeton school served as the community's storm shelter. Today, it is a private residence.

The early round of storms continued east, with another strong tornado tracking 18 miles across northern

Forty Years Continues on page 12

40 YEARS AGO *(Continued from page 11)*

Sequoyah County, OK shortly before 6 pm. Initially touching down north of Gore and south of Lake Tenkiller Dam, the twister moved northeast and struck near the communities of Box, Blackgum and Marble City. Nine homes were completely destroyed, one taken off its foundation with only the refrigerator remaining, while 47 others were damaged. Several head of cattle were killed, and an estimated 15 square miles of timberland was destroyed. Six people suffered injuries. As the storms moved into northwest Arkansas, two tornadoes touched down in Benton County. The first struck just southeast of Rogers, destroying a mobile home and damaged some resort property along Beaver Lake. The second touched down briefly near Cave Springs doing minor damage.

The second wave of tornadic storms produced tornadoes near Checotah, OK (McIntosh CO.) and along a 15 mile path through southern Pittsburg County, OK just after 9 pm. A brief, but strong tornado struck the town of Wister, OK (LeFlore Co.) at about 10 pm, destroying one house and one mobile home, and causing significant damage to one business and several other homes. Tornadoes then struck northwest Arkansas a short time later. The first hit west of Berryville (Carroll Co.), demolishing a couple of mobile homes and injuring 2 people. The final tornado of the night in Tulsa's present day forecast area touched down just east of Van Buren (Crawford Co.) along Interstate 40, with significant damage occurring in two mobile home parks. There was also several cars and trucks blown off the highway and a weighing station was damaged. While considered a "weak" tornado, it caused 23 injuries. ⚡

A Life-Saving Discovery



Union City tornado in its mature stage

On May 24, 1973, a violent tornado caused extensive damage as it passed through the heart of the small farming community of Union City, Oklahoma, just west of Oklahoma City. The newly commissioned Doppler radar at NOAA's National Severe Storms Laboratory observed this tornado, and researchers from the laboratory's Tornado Intercept Project photographed the tornado's life

cycle. The radar, coupled with the photographic evidence of the tornado's development, revealed previously unknown information about motion inside thunderstorms with a persistent rotating updraft (known as supercell storms). This discovery led to dramatic improvements in accuracy and lead time in forecasting severe storms nationwide, and along with them, the ability to save lives and prevent serious storm-related injuries.

Researchers discovered that the Union City tornado produced a unique Doppler radar velocity measurement called a tornadic vortex signature, which formed within the storm's rotating updraft (also known as a mesocyclone). Initially, the signature appeared at mid-altitudes in the updraft over 20 minutes before tornado touchdown...well before the tornado appeared. As the storm grew and intensified, the signature lengthened, both upward toward the storm's top and downward toward the ground. The radar signature reached the ground at roughly the same time as the tornado. It was strongest and extended throughout most of the storm's depth when the tornado was strongest and disappeared as the tornado died.



NSSL's early Doppler research was carried out on a surplus 10-cm military radar. Data were recorded on magnetic tape...it took a few months to be processed on a computer before researchers could first see the data.

The National Weather Service was so impressed by the warning potential of these Doppler velocity signatures, that it joined with the Federal Aviation Administration, the Air Force's Air Weather Service, and National Severe Storms Laboratory in the Joint Doppler Operational Project from 1977 to 1979, to test the radar's ability to improve tornado warnings. The test was so successful that these organizations immediately set up an office to acquire and establish a national network of Doppler weather radars. ⚡

<http://www.nssl.noaa.gov/about/events/40thanniversary/stories/unioncity.html>